

NEW SPECIES AND NEW COMBINATIONS IN
ERICAMERIA (ASTERACEAE: ASTEREA)

Roland P. Roberts¹

Department of Biological Science
Towson University
Towson, Maryland 21252, U.S.A.
rroberts@towson.edu

Lowell E. Urbatsch

Department of Biological Science
Louisiana State University
Baton Rouge, Louisiana 70803, U.S.A.
leu@lsu.edu

John Anderson

Bureau of Land Management
Phoenix Field Office
21605 North Seventh Avenue
Phoenix, Arizona 85207
John_Anderson@blm.gov

ABSTRACT

One new species of *Ericameria* is described and two new combinations are proposed. Using morphological and molecular evidence we describe *Ericameria arizonica* Roberts, Urbatsch, & Anderson, presently known only from the Grand Canyon, Arizona, and propose the elevation of *E. discoidea* var. *linearis* and *E. discoidea* var. *winwardii* to species rank as *E. linearis* (Rydb.) Roberts & Urbatsch and *E. winwardii* (Dorn & Delmatier) Roberts & Urbatsch, respectively.

RESUMEN

Se describe una nueva especie de *Ericameria* y se proponen dos nuevas combinaciones. Usando datos morfológicos y moleculares, describimos *Ericameria arizonica* Roberts, Urbatsch, y Anderson, conocida solamente de El Gran Cañón, Arizona, y proponemos la elevación de *E. discoidea* var. *linearis* y *E. discoidea* var. *winwardii* a nivel de especie como *E. linearis* y *E. winwardii*, respectivamente.

Sequence-based phylogenetic investigations and taxonomic studies of *Ericameria* done, in part, for preparing the treatment to appear in *Flora North America* (Asteraceae: Astereae) have revealed one previously undescribed species and indicate that two known varieties would be more appropriately treated at specific rank. *Ericameria arizonica* from Arizona is herein described as new and *E. discoidea* (Nutt.) G.L. Nesom var. *linearis* (Rydb.) G.L. Nesom and *E. discoidea* (Nutt.) G.L. Nesom var. *winwardii* Dorn & Delmat. are raised to the rank of species as *E. linearis* and *E. winwardii*. ETS/ITS sequence data (Roberts & Urbatsch 2003, 2004; Urbatsch et al. 2003) were invaluable in circumscribing the genus that in recent decades had been the subject of numerous investigations (Urbatsch 1978; Urbatsch & Wussow 1979; Nesom 1990; Nesom et al. 1990; Nesom & Baird 1993; Anderson 1995; Urbatsch & Roberts 2004). Although low levels of interspecific sequence variation disallowed an assessment of detailed

¹ Author for correspondence.

relationships among species, such data were not inconsequential either and offered some support for our present taxonomic decisions. *Ericameria*, in its most recent rendition, consists of 36 species that occupy arid habitats of western North America ranging from northern Mexico northward into Canada. Two species are restricted to Baja California, *E. juarezensis* (Moran) Urbatsch and *E. martirensis* Wiggins, while the other 34 grow in part or wholly north of Mexico.

NOMENCLATURAL TREATMENT

Ericameria arizonica R.P. Roberts, Urbatsch & J. Anderson, sp. nov. (**Fig. 1**). TYPE: U.S.A. ARIZONA. Coconino Co.: Grand Canyon National Park, South Rim, Mather Point, eastern edge of view point E of paved walkways, north-facing Kaibab Limestone cliff edges shaded by pinyon pine, 1 Oct 1998, N. Brian 98-291 (HOLOTYPE: ASCI).

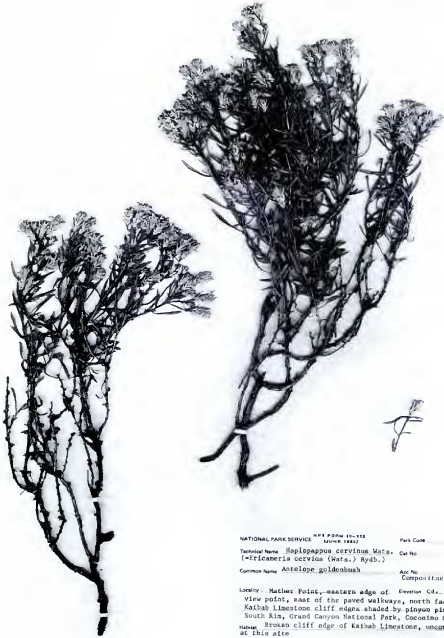
Frutices ad 0.5 m alti; caules ramosi resinosi glandibus stipitatis; folia ascendentia vel effusa elliptica vel anguste oblanceolata 10–35 mm longa 2–5 mm lata glandulosa typice resinosi-punctata; involucri obconica 5.5–7.5 mm longa 2.5–4 mm lata; phyllaria 4–5-seriata valde gradata lanceolata ad elliptica 2–7 mm longa 0.5–1.2 mm lata, apicibus acutis ad cuspidatis aliquando acuminatis; capitula radiata, flosculis 12–20; flosculi radii 1–8; flosculi disci 5–15, corollis 5–7 mm longis, ramis stylorum 2–2.7 mm longis, appendicibus stylorum 1.3–1.7 mm longis. cypselae 4–5.5 mm longae glabrae vel dense sericeae; pappi albidii 4–5.5 mm longi.

Shrubs to 0.5 m. Stems branched, bark reddish tan becoming darker when older, stipitate glandular, usually resin coated. Leaves ascending to spreading, elliptic to narrowly oblanceolate, 10–35 × 2–5 mm, flat to somewhat concave adaxially, margins entire, glandular, typically resin-dotted, apices acute, apiculate, midvein evident and 1–2 fainter collateral veins often present; axillary fascicles of leaves absent. Capitulescences of cymose clusters to 4 cm wide. Involucres obconic, 5.5–7.5 × 2.5–4 mm. Phyllaries in 4–5 series, strongly graduated, tan, lanceolate to elliptic, 2–7 × 0.5–1.2 mm, mostly chartaceous, margins abruptly constricted at base of appendage, apices acute to cuspidate, sometimes long acuminate, usually recurved, midvein faintly evident, often resin dotted. Capitula radiate, flowers 12–20. Ray flowers 1–8, laminae elliptic, 3–4 × 0.8–1.3 mm. Disc flowers 5–15, corollas 5–7 mm, tubes glabrous, lobes 0.5–1 mm. Style-branches 2–2.7 mm, appendages attenuate, 1.3–1.7. Cypselae 4–5.5 mm, glabrous to densely sericeous. Pappi whitish-tan, 4–5.5 mm.

Etymology.—*Ericameria arizonica* is named for Arizona, the only state from which this species is presently known.

Distribution, ecology, and phenology.—The species has been collected from several sites along the south rim of the Grand Canyon where it grows on steep limestone cliffs, ca. 2100–2300 m. Flowering occurs in September and October. Chromosome number unknown.

Discussion.—*Ericameria arizonica* is allied to *E. cervina* (S. Watson) Rydb., a species that typically occurs on granitic and other non calcareous substrates. *Ericameria arizonica* is distinguished from *E. cervina* by having stipitate glandular hairs especially on its inflorescence branches, much narrower, elliptic to



NATIONAL PARK SERVICE NPS Form 98-112 March 1982 Park Code
 Technical Name *Hesperopappus cervinus* Wats. Det. No.
 (*Ericameria cervina* (Wats.) Rydb.)
 Common Name Antelope goldenbush Acc. No.
Computer File No.
 Locality Mathew Point, eastern edge of Elevation CA. 7,100 ft
view point, east of the paved walkway, north facing
Kaibab Limestone cliff edge, shaded by pinyon pine,
South Rim, Grand Canyon National Park, Coconino Co., AZ
 Habitat Broken cliff edge of Kaibab Limestone, uncommon
 at this site
 Date & Nancy Brian 98-291 Date Oct. 1, 1998
 Collected by HERBARIUM COLLECTION

FIG. 1. Holotype for *Ericameria arizonica*, N. Brian 98-291 (ASC). Size marker in lower left corner equals 1 cm.

narrowly obovate leaves, more acute phyllary apices, and its occurrence on limestone substrates (Figs. 1, 2). It is distinguished from *E. nana* Nutt., another species in this complex, by its taller stature, more widely spaced leaves, acute phyllaries, lack or reduction of axillary leaf fascicles, and the presence of stipitate glandular pubescence. Certain specimens, mostly from Nevada, such as *Train* 2494 (WTU), 20 mi W of Panaca in Lincoln County, are similar to *E. arizonica* in leaf form but lack the stipitate glands and possess axillary fascicles of leaves. Relationships among the stipitate populations are not presently known.

Samples of all three taxa were included in the macromolecular-based investigations of *Ericameria* (Roberts & Urbatsch 2003), where less than 1% divergence was detected among their ETS/ITS sequences. Similar sequence differences for this region of DNA were observed among more distantly related species of *Ericameria*. *Ericameria arizonica* and *E. cervina* consistently occurred in a clade with *E. lignumviridis* (S.L. Welsh) G.L. Nesom, *E. nana*, *E. obovata* (Rydberg) G.L. Nesom, and *E. watsonii* (A. Gray) G.L. Nesom. Relationships of *E. arizonica*, designated "*E. cervina* 1" in our above cited molecular study, within this lineage were usually unresolved. The relationship of *E. cervina*, designated "*E. cervina* 2" in the molecular study, was sometimes weakly associated with *E. nana*. Despite the lack of sequence divergence among these species, they are clearly distinguished by morphological traits and substrate preferences.

PARATYPES. U.S.A. Arizona: Coconino Co.: Grand Canyon, hotel to Hopi Point, near rim, 6900 ft, 5 Jun 1927, *Blake* 9818 (US); top of Lookout Trail near rim, 6900 ft, 5 Jun 1927, *Blake* 9815 (US); South Rim, Maricopa Point, NE edge of the fenced enclosure E of Lost Orphan Mine, vertical edges and cliff breaks in north-facing Kaibab Limestone, ca. 7000 ft, 8 Sep 1998, *Brian* 98-279 (ASC); trail from Grand View, 26-28 Sep 1913, *Eastwood* 3580 (CAS); Bright Angel Trail, 22 Oct 1905, *Eastwood* 16 (US); same locality, *Eastwood* 18 (US); head of Bright Angel Trail, common on limestone only along the rim, 6800 ft, 26 Sep 1920, *Hall* 1191 (D11); Grand View, 7400 ft, growing from cleft in rock, 26 Sep 1920 (D11); Grand View Trail, 22 Aug 1907, *Thornber & Hochdoerffer* 2931 (CAS).

Ericameria linearis (Rydberg) R.P. Roberts & Urbatsch, comb. nov. BASIONYM *Macronema lineare* Rydberg, Mem. New York Bot. Gard. 1:384, 1900. *Haplopappus macronema* A. Gray subsp. *linearis* (Rydberg) H.M. Hall, Carnegie Inst. Wash. Publ. 389:206, 1928. *Haplopappus macronema* var. *linearis* (Rydberg) R.D. Dorn, Vasc. Pl. Wyoming 295, 1988. *Ericameria discoidea* (Nutt.) G.L. Nesom var. *linearis* (Rydberg) G.L. Nesom, Phytologia 68:153, 1990. TYPE: U.S.A. WYOMING: Teton Forest Reserve, N.W. Wyoming, Gros Ventre River, *Twedy* 557 (HOLOTYPE NY).

Distribution, ecology, and phenology.—*Ericameria linearis* grows on dry, stony slopes at elevations around 2300 m and flowers from late summer into fall. It has been documented for Beaverhead County in southwestern Montana and in Fremont, Park, Sublette, and Teton counties in northwestern Wyoming.

Discussion.—Leaves linear in shape, 1-2.5(3) mm wide, pubescence glandular or rarely glabrous, sometimes floccose-tomentose but still glandular; and involucre less than 11 mm tall characterize *Ericameria linearis*. Its probable sister taxon, *E. discoidea*, differs in having glandular but otherwise glabrous,



FIG. 2. Portion of probable isotype for *Ericameria cervina* based on *Haplopappus cervinus* Wats., Utah, Antelope Canyon, 1872, Wheeler (US). Size marker in lower left corner equals 1 cm.

oblong to oblanceolate leaves, mostly wider than 3 mm often with crisped margins and a darker green color, and involucre 10–13 mm tall. *Ericameria linearis* grows in southwestern Montana and northwestern Wyoming. Except for the possibility of its being sympatric with *E. discoidea* in southwestern Montana, the geographic ranges for the two species do not overlap. The latter is widespread

in mountainous areas of southeastern Oregon, east-central California, Nevada, Utah, and Colorado; and it is not known from Wyoming. *Ericameria linearis* grows at lower altitudes than *E. discoidea* and for the most part at higher latitudes. Rydberg (1900) originally described *E. linearis* as a distinct species in the genus *Macronema* that, for the most part, is now included within the concept of *Ericameria*. Hall (1928) reduced the species to subspecific rank in *Haplopappus macronema* A. Gray, and others have likewise retained its infraspecific status. We restore the taxon to specific rank based on its morphological differences and its restricted, putatively allopatric distribution.

Ericameria winwardii (R.D. Dorn & C.H. Delmatier) R.P. Roberts & Urbatsch, stat. nov. *Ericameria discoidea* var. *winwardii* Dorn & Delmatier, Madroño 52:63, 2005. TYPE: U.S.A. WYOMING, Lincoln Co.: ca. 11 mi SW of Kemmerer, 41° 42' 47" N, 110° 43.381' W, 2135 m, 26 Jul 2002, Dorn 9393 (HOLOTYPE: RM, ISOTYPES: BRY, COLO, IDS, MO, NY).

Distribution, ecology, and phenology.—*Ericameria winwardii* is known from Bear Lake County, Idaho, and Lincoln County, Wyoming. It grows on silty-clay and clay-shale slopes between 2050 and 2150 m (Dorn & Delmatier 2005). Flowering occurs late summer to fall.

Discussion.—Dorn and Delmatier (2005) observed a greater similarity of *Ericameria winwardii* to *E. linearis* than to *E. discoidea* on the basis of leaf form and pubescence. *Ericameria winwardii* is readily distinguished from *E. linearis* and *E. discoidea* by its smaller stature, floccose-tomentose pubescence throughout, absence of glandular hairs, and 10 or fewer florets per capitulum. Its stems lack the white, felt-like tomentum characteristic of *E. discoidea*. *Ericameria winwardii* appears to grow in finer, moister, less sloping soils than the other two species which are adapted to dry, well-drained, stony slopes and alpine fell-fields (Hall 1928). We initially thought specimens of *E. winwardii* represented *E. linearis* but soon learned of their differences. Dorn and Delmatier (2005) independently concluded that *E. winwardii* represented an undescribed taxon, which they elected to treat as a variety within the *E. discoidea* complex. We conclude that it deserves specific rank due to its unique morphology, restricted, allopatric distribution, and adaptation to different edaphic conditions.

The sequence-based investigations of Roberts and Urbatsch (2003) included *Ericameria winwardii* (identified as *E. discoidea* var. *linearis* in that study) and typical *E. discoidea* (Nutt.) G.L. Nesom. In the combined analyses of the ETS/ITS data both taxa were placed in a lineage with *E. nauseosa* (Pall. ex Pursh) G.L. Nesom & G.I. Baird and *E. parryi* (A. Gray) G.L. Nesom & G.I. Baird. The former and latter pairs of taxa were sister in the Bayesian analysis of the ETS data, whereas, the combined ETS/ITS resulted in a trichotomy consisting of *E. discoidea* and *E. winwardii* with the third branch supporting *E. nauseosa* and *E. parryi*. Relationships among these taxa were unresolved within *Ericameria* when the ITS data were analyzed independently. As with *E. arizonica*,

the percent sequence divergence among these taxa was comparable to that of other species in the genus (Roberts & Urbatsch 2003). Such low levels of divergence might indicate a relatively recent radiation of taxa or some measure of long generation time such that mutations in ETS and ITS regions accumulate slowly. Taxa in the *E. discoidea/nauseosa* lineage are characterized by a dense felty to floccose tomentum on some or all of their organs. Another measure of similarity among species in this clade is their ability to hybridize. Anderson and Reveal (1966) demonstrated the intermediacy of *E. ×bolanderi* (A. Gray) G.L. Nesom & G.I. Baird between *E. discoidea* and *E. nauseosa* in several morphological and anatomical characters providing abundant, circumstantial evidence for its hybrid origin. At the time of their study the putative parental taxa were regarded as belonging to different genera, *Halopappus* section *Macronema* and *Chrysothamnus*. Subsequently, Anderson (1984) provided evidence for hybrids forming between *E. nauseosa* and *E. parryi* resulting in a stabilized derivative taxon regarded by Nesom and Baird (1993) as *E. ×uintahensis* (L.C. Anderson.) G.L. Nesom & G.I. Baird.

Despite the low level of resolution based on sequence data, *Ericameria discoidea*, *E. linearis*, and *E. winwardii* are morphologically distinct and apparently geographically allopatric. Observations of populations in nature suggest divergence in edaphic adaptations for *E. winwardii* compared to *E. discoidea* and *E. linearis* (Dorn & Delmatier 2005). Features of the leaves including shape, pubescence and margin characteristics can be used to distinguish among them. Distributional data indicate that the geographical ranges for the three taxa are distinct (Dorn & Delmatier 2005).

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REFERENCES

- ANDERSON, L.C. 1984. *Chrysothamnus nauseosus* ssp *uintahensis*: a stabilized hybrid. Great Basin Naturalist 44:416–420.
- ANDERSON, L.C. 1995. The *Chrysothamnus-Ericameria* connection (Asteraceae). Great Basin Naturalist 55:84–88.
- ANDERSON, L.C. and J.L. REVEAL. 1966. *Chrysothamnus bolanderi*, an intergeneric hybrid. Madroño 18:225–256.
- DORN, R.D. and C.H. DELMATIER. 2005. A new variety of *Ericameria discoidea* (Asteraceae) from Idaho and Wyoming. Madroño 52:63–65.

- HALL, H.M. 1928. The genus *Haplopappus* – a phylogenetic study in the Compositae. Carnegie Institute of Washington Publication No. 389.
- NESOM, G.L. 1989. New combinations in *Ericameria* (Compositae: Astereae). *Phytologia* 67:104–106.
- NESOM, G.L. 1990. Taxonomic summary of *Ericameria* (Asteraceae: Astereae), with the inclusion of *Haplopappus* sects. *Macronema* and *Asiris*. *Phytologia* 68:144–155.
- NESOM, G.L. and G.I. BAIRD. 1993. Completion of *Ericameria* (Asteraceae: Astereae), diminution of *Chrysothamnus*. *Phytologia* 75:74–93.
- NESOM, G.L. and G.I. BAIRD. 1995. Comments on "the *Chrysothamnus* - *Ericameria* connection." *Phytologia* 78:61–65.
- NESOM, G.L., Y. SUH, D.R. MORGAN, and B.B. SIMPSON. 1990. *Xylothamia* (Asteraceae: Astereae), a new genus related to *Euthamia*. *Sida* 14:101–116.
- ROBERTS, R.P. and L.E. URBATSCH. 2003. Molecular phylogeny of *Ericameria* (Asteraceae, Astereae) based on nuclear ribosomal 3'ETS and ITS sequence data. *Taxon* 52:209–228.
- ROBERTS, R.P. and L.E. URBATSCH. 2004. Molecular phylogeny of *Chrysothamnus* and related genera (Asteraceae, Astereae) based on nuclear ribosomal 3'ETS and ITS sequence data. *Syst. Bot.* 29:199–215.
- URBATSCH, L.E. 1978. The Chihuahuan Desert species of *Ericameria* (Compositae: Astereae). *Sida* 7:298–303.
- URBATSCH, L.E. and J.R. WUSSOW. 1979. The taxonomic affinities of *Haplopappus linearifolius* (Asteraceae - Astereae). *Brittonia* 31:265–275.
- URBATSCH, L.E., R.P. ROBERTS, and V. KARAMAN. 2003. Phylogenetic evaluation of *Xylothamia*, *Gundlachia*, and related genera (Asteraceae, Astereae) based on ETS and ITS nrDNA sequence data. *Amer. J. Bot.* 90:634–649.
- URBATSCH, L.E. and R.P. ROBERTS. 2004. New combinations in the genus *Gundlachia* and four new genera of Astereae (Asteraceae) from northern Mexico and the southern United States. *Sida* 21:243–257.